METHOD FOR ELIMINATING MULTIPLE-ACCESS INTERFERENCE AND A MOBILE STATION

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BACKGROUND OF THE INVENTION

The invention relates to a method for eliminating multiple-access interference in a CDMA cellular radio system having cells each comprising at least one base station communicating with mobile stations residing in the cell and informing the mobile stations of at least one spreading code used in a neighbouring cell, the mobile stations measuring the code phase and power level of a channel of the neighbouring cell using the known spreading code.

CDMA is a multiple access method based on the spread spectrum technique, and it has been applied recently in cellular radio systems together with the earlier developed FDMA and TDMA techniques. CDMA has several advantages over the earlier developed techniques, such as higher spectral efficiency and simple frequency planning.

In CDMA, the narrow-band data signal of the user is multiplied to a relatively broad band with a spreading code having a considerably broader band than the data signal. Known test systems use bandwidths such as 1.25 MHz, 10 MHz and 25 MHz. The multiplication spreads the data signal over the entire available band. All users transmit on the same frequency band simultaneously. A spreading code is assigned to each connection between a base station and a mobile station, and the signals of different users can be distinguished from each other in the receivers on the basis of the spreading code of each user.

Correlators provided in the receivers are synchronized with the desired signal, which is recognized on the basis of the spreading code. In the receiver, the data signal is restored to the original band by multiplying it again with the same spreading code as at the transmission stage. In an ideal case, signals multiplied with some other spreading code do not correlate and are not restored to the narrow band. From the viewpoint of the desired signal, they thus appear as noise. One attempts to select the spreading codes of the system in such a way that they are orthogonal with respect to each other, i.e. do not correlate with each other.

In a typical cellular radio environment, signals between a mobile station and a base station propagate over several paths between a transmitter and a receiver. This multipath propagation is mainly due to reflections of the signal from the surrounding surfaces. Signals that have propagated over different paths arrive at the receiver at different times due to their different propagation time delays. CDMA differs from conventional FDMA and TDMA in that the multipath propagation can be utilized in signal reception. A so-called rake receiver comprising one or more rake branches or correlators is a widely used receiver solution in CDMA. Each correlator is an independent receiver unit, the function of which is to assemble and demodulate one received signal component. The implementation of a rake branch is described more closely in *Modern Communications and Spread Spectrum*, Chapter *12*, G. Cooper, C. McGillem, McGraw-Hill, New York *1986*. A CDMA receiver typically comprises a separate impulse response measuring equipment, the function of which is to search out different signal components transmitted with a desired spreading code, and detect the phases of the signal components. Each rake branch or correlator can be controlled so that it will be

synchronized with a signal component propagated over a different path. In a conventional CDMA receiver, the signals of the correlators are combined in an advantageous way, thus obtaining a signal of high quality. The signal components received by the correlators may have been transmitted from one base station, or in the case of macrodiversity, from a plurality of base stations.

Generally speaking, the spreading codes are not orthogonal at all values of the delay. Accordingly, signals delayed in different ways cause interference in the signal detection. Such interference caused by different users to one another is called multiple-access interference.

Each base station transmits to all of the mobile stations residing within its area on the same frequency band. The same frequency band is typically also used in adjacent cells. To minimize multiple-access interference, the spreading codes used by each particular base station within a cell are attempted to be selected so that they are orthogonal with respect to each other. Power control is also used to eliminate the effect of multiple-access interference within a cell.

In the CDMA cellular radio system, it is possible to use a channel called a pilot channel. The pilot channel is a data-unmodulated signal transmitted with a certain spreading code. Thus it contains no data. The pilot channel is transmitted on the same frequency band on which the actual traffic channels are located; the pilot channel can be distinguished from its traffic channels only on the basis of the spreading code. The pilot channel is used e.g. in power measurements and in generating a coherent phase reference. A base station may also inform the mobile stations moving within its area about the spreading codes of the pilot channels of the base stations of neighboring cells. In this way, the respective mobile stations are able to identify the transmissions of the neighbouring cells. This informing can be utilized in the handover procedure.

When a mobile station approaches the edge of the coverage area of its presently dedicated base station, a signal from a neighboring base station, which is within the same frequency range as the transmission of the presently dedicated base station, begins to appear as an increasingly strong interference in the receiver of the mobile station. This interference is particularly disadvantageous, as the spreading codes used in the neighboring cells are not necessarily fully orthogonal with the codes used in the mobile station's own present cell. Moreover, the power control of the base station of the neighboring cell, if there is any in use, does not take the adjacent cells into account.

SUMMARY OF THE INVENTION

The object of the persent invention is to reduce the effect of multiple-access interference in a situation where a desired signal from a presently dedicated base station is at minimum and interference from at least one neighbouring cells is at maximum, i.e. within the boundary area of at least two cells.

This is achieved by means of a solution according to the method described in the foregoing background section which is characterized in that the code phase and power level of the measured channel using the known spreading code of the neighboring cell are utilized in the detection of the desired signal from the received signal at the mobile station.

The invention also relates to a mobile station intended for use in a CDMA cellular radio system having cells each comprising at least one base station communicating with mobile stations residing in the cell, the mobile station having means for measuring the code phase and power level of a channel using a known spreading code of a base station in